Table of Contents

E70 Advanced Crash Safety Module (ACSM)

Subject Page

Advanced Crash Safety Module

Model: E70

Production: From Start of Production

OBJECTIVES

After completion of this module you will be able to:

- Describe the different functions of the ACSM on the E70.
- Identify the components that comprise the ACSM on the E70.
- Diagnose functions of the ACSM system on the E70.
- Service components on the ACSM system used on the E70.

Introduction

Advanced Crash Safety Module ACSM

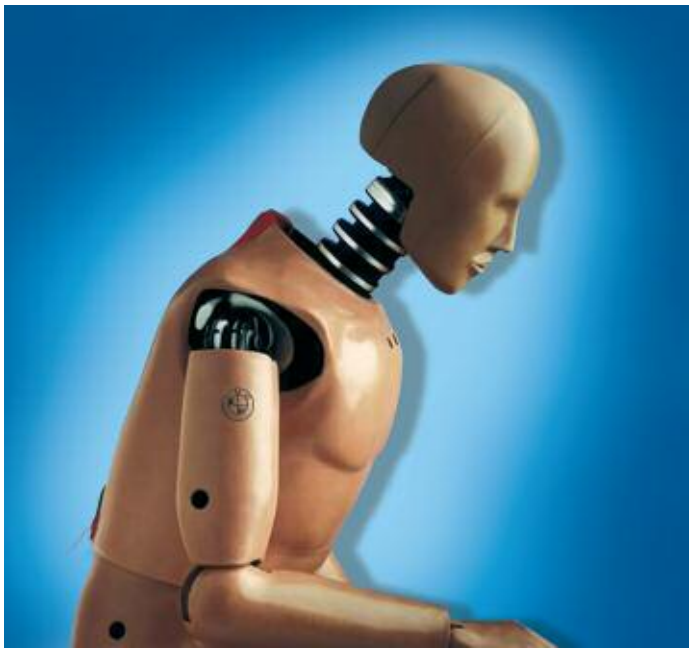
The safety system ACSM is used in the E70. The task of ACSM is to detect accident situations critical for the vehicle occupants and to activate the necessary restraint systems selectively corresponding to the crash severity.

The crash safety module performs internal diagnosis and monitors all inputs and outputs. Any faults that may occur are stored nonvolatile in the crash safety module and indicated to the driver by way of the airbag indicator lamp in the instrument cluster.

Communication with other control units in the vehicle's system network takes place via the K-CAN and the F-CAN.

In the event of a crash, a K-bus telegram is transmitted (provided a telephone is installed) via an additional separate data line to the Telematics Control Unit (TCU) and the emergency call triggered (depending on national version).

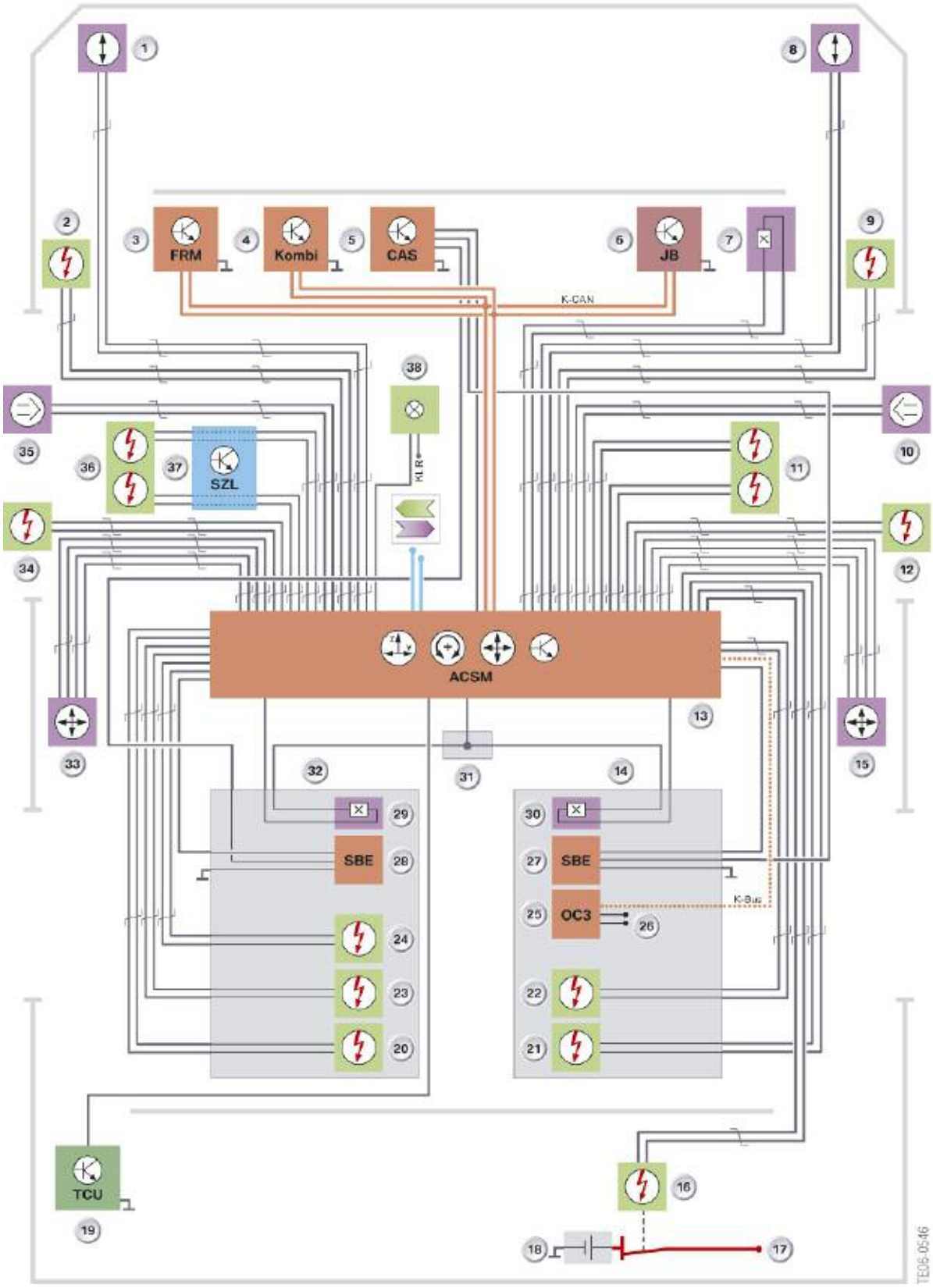
It is possible to encode the crash safety module via the K-CAN. Diagnosis of the crash safety module takes place via the diagnosis CAN to the gateway that is located in the Junction-box ECU on the E70.



F-CAN Signals at ACSM Control Unit

In/Out	Signal	Source	Function
IN	Vehicle Speed	Wheel Speed Sensors Dynamic Stability Control DSC	Information for recognizing possible rollover situation
IN	YAW Rate	Dynamic Stability Control DSC	Information for recognizing possible rollover situation
IN	Steering angle	Steering angle sensor Steering column switch cluster	Information for recognizing possible rollover situation

Schematic Circuit Diagram ACSM E70



Index	Explanation
1	Up-front sensor, left
2	Head airbag, front passenger's side
3	Footwell module FRM
4	Instrument cluster
5	Car Access System (CAS)
6	Junction-box ECU
7	Switch for passenger airbag deactivation
8	Up-front sensor, right
9	Head airbag, driver's side
10	Door pressure sensor, right
11	Front passenger airbag, 2-stage
12	Adaptive seat belt force limiter, right
13	ACSM ECU
14	Front passenger's seat
15	B-pillar satellite, right
16	Safety battery terminal
17	Main power connection to starter and alternator
18	Ground
19	Telephone
20	Seat belt pretensioner, left
21	Seat belt pretensioner, right
22	Side airbag, right
23	Side airbag, left
24	Anchor-fitting pretensioner
25	Seat occupancy detector
26	Power supply, seat occupancy detector
27	Seat occupancy detector (SBE for EU), front passenger
28	Seat occupancy detector (SBE for EU), driver
29	Seat belt buckle switch, driver
30	Seat belt buckle switch, front passenger
31	Ground point
32	Driver's seat
33	B-pillar satellite, left
34	Adaptive seat belt force limiter, left
35	Door pressure sensor, left
36	Driver's airbag, two-stage
37	Steering column switch cluster SZL
38	Indicator lamp for passenger airbag deactivation
K-CAN	Body CAN
K-Bus	Body Bus
KL R	Terminal R

Functions

Basic Tasks of ACSM

The task of advanced crash safety module is to evaluate permanently all the sensor signals in order to identify a crash situation. As a result of the sensor signals and their evaluation, the crash safety module identifies the direction of the crash and the severity of the impact.

Also included is information on the occupants and whether they have their seat belts fastened or not. From this information, measures are taken to selectively trigger the necessary restraint systems. The ACSM monitors itself at all times and indicates that the system is in standby mode by the airbag indicator lamp briefly going out after every "ignition ON" status. If a fault occurs during operation, it is indicated by the airbag indicator lamp and is additionally stored in the fault code memory. This fault code memory can be read out for diagnostic purposes.

In the event of a crash, this is communicated to the other users in the bus-system net work by way of a bus telegram. The relevant control units respond to this telegram by executing their own activities.

These activities include:

- Opening the central-locking system
- Activating the hazard warning flashers
- Switching on the interior lights
- Deactivating the fuel pump
- Switching off the alternator
- Automatic emergency call

Another function of ACSM is the seat belt reminder function, which uses optical and acoustic signals to remind the driver and front passenger to fasten their seat belts.

Crash-Relevant Functions

The crash safety module must fulfill the following crash-relevant functions:

- Evaluating the sensor signals
- Detecting a crash and determining the triggering times and the order
- Triggering the output stages of the firing circuits
- Output of a crash telegram for other users in the communication system network

- Crash entries
- Emergency call functions
- Driver's seat position recognition

Evaluating the Sensor Signals

The crash safety module incorporates a longitudinal acceleration sensor and a transverse acceleration sensor. The sensors serve to detect and verify front-end, side-on and rear-end crashes.

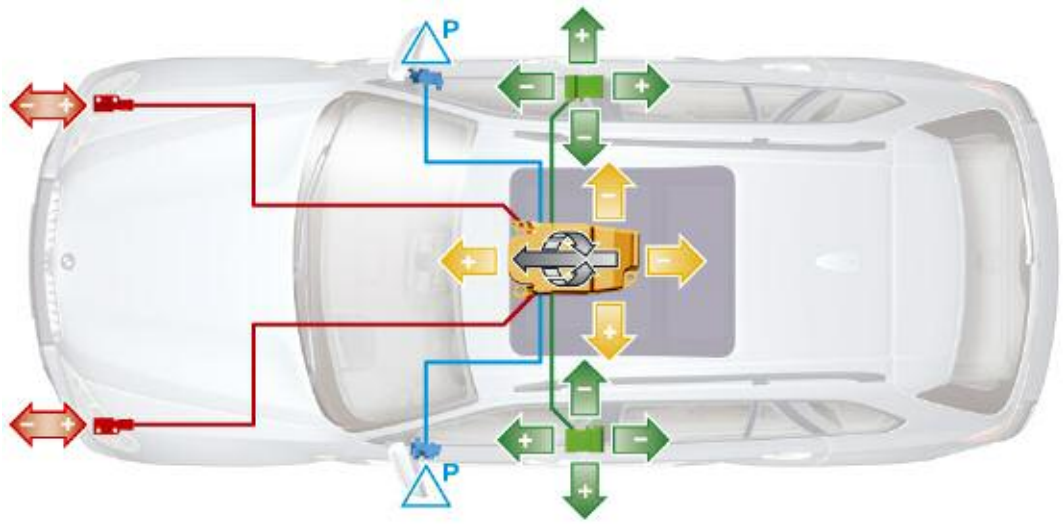
The crash safety module additionally contains a sensor for rollover detection. This function has been adopted from the E64 and activates the curtain airbag and the seat belt pretensioners in the E70.

Satellites are installed at the B-pillars. The satellites each consist of a longitudinal acceleration sensor and a transverse acceleration sensor.

Together with the transverse acceleration sensor in the crash safety module, the transverse acceleration sensors serve to detect side-on crashes.

Together with the longitudinal acceleration sensor in the crash safety module, the longitudinal acceleration sensors serve to detect front-end and rear-end crashes.

Sensors in the E70



The acceleration sensors measure the positive acceleration (+) and the negative acceleration (- / deceleration) in the X and Y directions.

The resultant from the x and y signals is the definitive factor in determining the direction of the impact.

Note: US vehicles have additional up-front sensors and door pressure sensors.

Detecting a Crash and Determining the Triggering Times and the Order

The crash safety module uses the values transmitted by the sensors to determine the direction and severity of the crash.

The threshold values of two independent sensors must be detected simultaneously in order to detect a crash. In the case of a front end crash, for example, the acceleration values from the B-pillar satellite and from the longitudinal-acceleration sensor must be detected in the crash safety module.

Based on the crash severity and direction, an algorithm determines the triggering (firing) points and the order of the restraint systems to be activated.

Triggering the Output Stages of the Firing Circuits

The firing-circuit output stages are only triggered if the corresponding thresholds are detected by two different sensors simultaneously, for example the B-pillar satellite and the crash safety module.

From "Terminal R ON" the crash safety module is supplied with power by the Car Access System CAS and is ready for operation on completion of the system selftest. The firing capacitors, which also serve as an energy reserve, are charged up by a switching controller. The firing capacitors provide the firing energy in the event of a crash even if the power supply is interrupted as the result of the crash.

The output stages of the firing circuits consist of a high-side and a low-side power circuit breaker. The high-side power circuit-breaker controls the firing voltage, while the low-side power circuit-breaker switches to ground. The output stages of the firing circuits are controlled by the microprocessor.

The high-side and low-side power circuit breakers also serve the purpose of checking the firing circuits during the system self-test.

Outputting the Crash Telegram

In the event of a crash involving triggering of the restraint systems, the crash safety module sends a crash telegram to the users in the bus-system network. As a result, the respective control units perform the following functions corresponding to the crash severity:

Function	ECU
Shut down electric fuel pump (as from 6-cylinder and diesel engines)	Electric fuel pump (EKP) module
Shut down electric fuel pump on 4-cylinder engines	DME
Switch off alternator	DME
Open central locking	Junction-box ECU
Switch on hazard warning lights	Footwell module
Switch on interior lights	Footwell module
Make emergency call	Telematics control unit

Crash Entries

In the event of a crash where one or more actuators are triggered, a crash entry is stored in a non-erasable memory. After three crash entries, a non-erasable fault entry is stored in the fault memory with the instruction to replace the crash safety module.

The three crash entries could also be stored during the course of an accident. Each crash entry is assigned a system time. The control unit remains capable of firing even after three crash entries.

The crash entries cannot be erased and serve the purpose of subsequent device diagnosis. A maximum of three crash entries can be stored. The control unit must then be replaced.

Emergency Call Functions

A manual and an automatic emergency call is provided as standard on US vehicles. Furthermore, the driver has the option of activating a breakdown call. Irrespective of whether the customer orders a telephone or not, each vehicle is equipped with a telematics control unit TCU, a telephone antenna, a hands-free kit as well as a GPS antenna for determining position.

Automatic Emergency Call

The crash safety module sends a crash telegram to the TCU in the event of a crash of corresponding crash severity. The TCU places an emergency call, which at the same time contains the location of the vehicle.

Parallel to this, attempts are made to set up a voice connection with the vehicle occupants to obtain more information on the accident (severity of the accident, number of injured) so that further rescue operations can be initiated.

Breakdown Call

The breakdown-call button in the E70 or a menu button in the central information display is used to establish a connection with the BMW Emergency Service in the relevant country.

Manual Emergency Call

The emergency-call button is located in the roof console. The emergency-call button is connected directly to the TCU. Pressing the emergency-call buttons establishes a voice connection with the relevant country provider. The voice connection is indicated by a flashing LED in the switch.

Emergency call button in roof functions center E70

Rollover Protection System

The rollover protection system is an important instrument for improving occupant protection in the event of the vehicle rolling over. The seat belt pretensioners and the curtain airbags are triggered in response to corresponding crash severity.

There are different factors which can cause a car to overturn or roll over. The most common causes are:

- The vehicle leaves the road. One side of the vehicle digs into a roadside ditch and the vehicle rolls over.
- The car hits a ramp (a crash barrier) on one side. The car rotates about its longitudinal axis as a result of the high angular velocity.
- The car skids sideways off the road surface and buries itself with its wheels in the soft soil. The kinetic energy could be sufficient to upend and overturn the car.
- The car skids sideways off the road into the curb and is upended.

The crucial factors which determine whether the car overturns are not just the angle but also the angular velocity at which the car is set into the roll. All these vehicle movements can also occur after a front-end, side-on or rear-end crash.

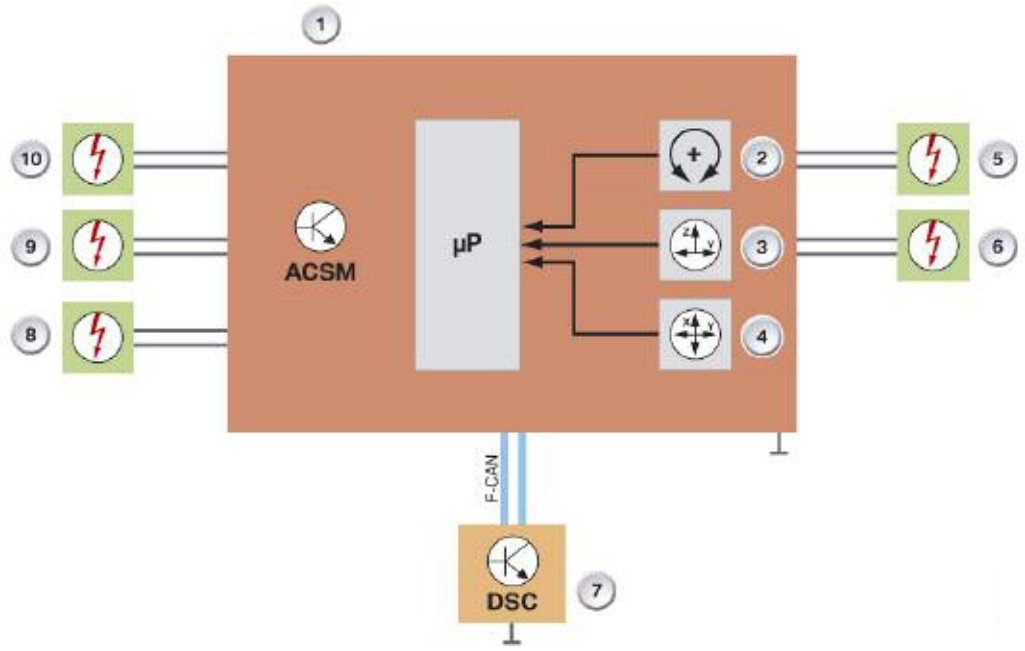
Rollover Detection

The module incorporates a special sensor system for detecting rollover situations. Besides the two sensors for longitudinal (x-axis) and transverse acceleration (y-axis), there is a yaw-rate sensor and a Low-g sensor for the z-axis and for the y-axis. ln addition to its own measured values, the crash safety module constantly receives information from the DSC relating to the current driving characteristics of the vehicle. This information serves to meet the demanding requirements relating to the triggering times.

The longitudinal and transverse acceleration sensors register the positive and negative vehicle acceleration in a measuring range of 0-100g. They serve to detect elevated acceleration and deceleration in a crash.

The two Low-g sensors have a narrow measuring range from 0-2g and can precisely detect low levels of acceleration and deceleration when, for example, the vehicle skids laterally off the road and buries itself with its wheels in the soft soil.

Crash Detection E70



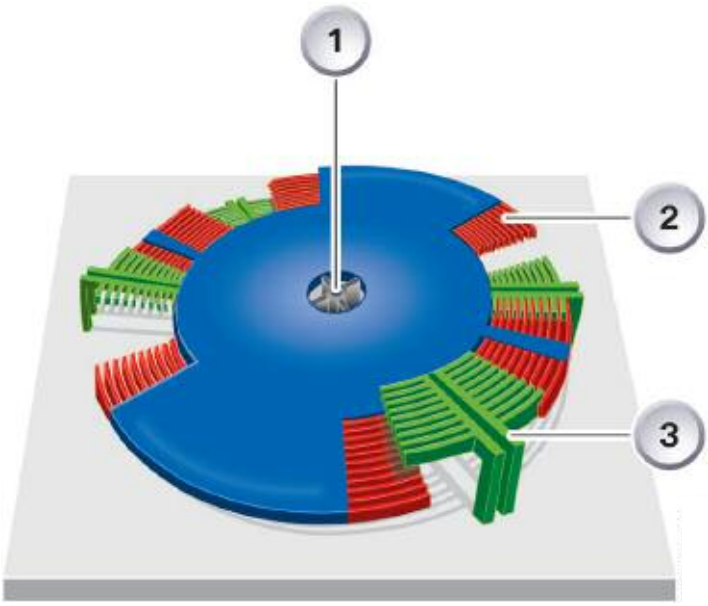
Index	Explanation	Index	Explanation
1	Crash safety module	6	Curtain airbag, front passenger
2	Rollover sensor	7	Dynamic stability control DSC
3	Low-g-sensors (z-/y-axis)	8	Seat belt pretensioner, driver
4	Longitudinal and transverse acceleration sensors	9	Curtain airbag, driver
5	Seat belt pretensioner, front passenger	10	Safety battery terminal

The sensors provide a voltage as measured variable. This voltage is a measure for the acceleration and is converted directly into digital signals in the sensor. The digital values are sent to the processor in the crash safety module for evaluation. The processor evaluates the signals from the longitudinal and transverse acceleration sensors and the two Low-g sensors. The signals of the yaw rate sensor are also included in the calculation. The results are compared with the stored algorithm. If the processor detects that a rollover situation is imminent, it will trigger the seat belt pretensioners and the curtain airbags.

Functional Principle of the Yaw Rate Sensor

A yaw rate sensor is used for detecting rollover situations. The yaw rate sensor has a comblike structure. It consists of a fixed comb structure (3) and a rotational oscillator (2) with amoving comb structure. Together, the comb structures form a capacitor. The rotational oscillator is fitted on bearings on a shaft (1) in its center.

Index	Explanation
1	Rotational axis
2	Rotational oscillator
3	Fixed comb structure



When the vehicle is in a horizontal position, the rotational oscillator turns within the comb structure and detects the change of direction (left/right). If the vehicle is brought into a tilting position (on a slope), the rotational oscillator is moved out of the comb structure.S

This causes a change in capacity, which in turn creates a change in voltage proportional to the deflection of the rotational oscillator in the mV range, which is evaluated as the measured variable.

The voltage change is directly related to the angle and, in the same way, the speed of the voltage change is directly related to the angle velocity. The angle and the angle velocity are the measurements used for the algorithm calculation.

The voltage values are directly converted into digital values in the yaw rate sensor and sent to the main processor for evaluation.

Seat Position Detection

Adaptive or intelligent restraint systems are developed with the aim of optimizing the protection offered by the restraint system under changing conditions. Besides the crash severity, the seated position and posture of the occupant are important factors in calculating the triggering procedures.

A seat position recognition facility is used on the driver's side in the E70 for the purpose of distinguishing persons in terms of their body size. The task of the seat position recognition facility is to distinguish between a relatively small person and a normal sized person within the forward/backward adjustment range of the seat. This recognition function is a further technical feature designed to increase occupant safety. The characteristics of the adaptive seat belt force limiter is correspondingly adapted to the driver's seat position.

In accordance with US legislation (FMVSS208) a facility for recognizing the size of persons must be provided on the driver's seat. This size recognition facility is based on the adjustment range of the forward/backward seat adjustment facility. On the E70, the exact position is determined by the actuator motor in the driver's seat.

A detailed description of the functional principle of the position detection system can be found in the Product Information "Seats"

System Monitoring Functions

The crash safety module must execute the following system monitoring functions:

- System self-test (pre-drive check)
- Cyclic monitoring
- Indication of system operability
- Fault indication and fault storage
- Fault output (diagnosis)
- Seat belt reminder function
- Deactivation of passenger airbags

System Self-test (pre-drive check)

ACSM performs a system self-test as from "Terminal R ON". The airbag indicator lamp is activated for about. 5 s during the system self-test.

When the system self-test is concluded and no fault has been found, the airbag indicator lamp goes out and the system is ready for operation.

Cyclic Monitoring

Once the system self-test has been successfully concluded and the system is ready for operation, a cyclic monitoring procedure is performed for fault monitoring purposes. Cyclic monitoring serves the purpose of internal diagnosis of the ECU and the overall airbag system. Cyclic monitoring is carried out for as long as the system is at "Terminal R ON".

Indication of System Operability

ACSM system operability is indicated by the airbag indicator lamp going out in the instrument cluster.

Fault Indication and Fault Storage

The crash safety module has a non-volatile fault memory. The airbag indicator lamp indicates any entry in the fault memory.

A distinction is made between internal and external faults when entering the fault code. Events such as triggering of the airbag or seat belt pretensioner are also stored in the fault memory.

Note: The entry of a triggered restraint system in the fault memory does not mean that the restraint system was defective in the crash situation, rather it only means that the restraint system is not available for further triggering.

Fault Output (diagnosis)

With the aid of the diagnostic tools (DIS plus, GT1), the fault memory can be read out via the diagnosis interface. After rectifying the faults or after replacing the triggered components, the fault memory can be cleared with the diagnosis command "Clear fault memory".

Seat Belt Reminder Function

All vehicles with ACSM have a Seat Belt Reminder function (SBR) as standard. The SBR function detects whether the driver and front passenger have fastened their seat belts. If not, a corresponding indicator reminds them to fasten their seat belt. Both seat belt buckle switches are monitored separately.

If the seat belt is not worn or the seat belt is unbuckled while driving at a speed in excess of about. 8 km/h, a corresponding audible and visual warning is given.

The seat belt warning is given by:

- Fixed seat belt indicator lamp (seat belt symbol)
- Variable seat belt indicator lamp (Check Control message)
- Audible warning provided by the gong
- Check control text message on vehicles with central information display

Note: If with terminal 15 the seat belt contact on the driver's side is not closed, an audible warning is triggered and the seat belt warning lamp activated for 6 seconds.

The SBR function is subdivided into two phases.

The first phase is the initialization, monitoring and warning begin with the vehicle stationary.The gong is additionally activated intermittently for maximum 90 s or until the seat belt is fastened. At the same time, the check control indicator is activated with the variable indicator lamp with the seat belt warning symbol for max. 23 s. On vehicles with the central information display, a text message "Fasten seat belt" is additionally displayed.

If the driver/front passenger does not fasten their seat belt within this period of time, the variable indicator lamp and the text message will go out after 23 s and the gong will switch off after 90 s. The fixed seat belt indicator lamp in the instrument cluster remains on until the seat belt is fastened.

The second phase involves monitoring while driving, i.e. the system monitors whether the occupants have their seat belts fastened during vehicle operation.If the front passenger seat is detected as occupied, the front passenger switch must also detect that the passenger seat belt is fastened so as not to trigger a warning. A visual and audible warning is triggered 15 s after unbuckling the seat belt while driving. The gong is activated intermittently for maximum 90 s or until the seat belt is fastened again. At the same time, the variable indicator lamp with the seat belt warning symbol is activated for max. 23 s. The fixed indicator lamp remains active until the seat belt is fastened again. On vehicles with the central information display, a text message "Fasten seat belt" is additionally displayed for maximum 23 s.

Note: If a warning was given for more than 90 s, the SBR function is not activated again until the seat belt has been fastened and unbuckled again.

Deactivation of SBR Function

The SBR would constantly trigger an alarm customers who predominantly use the vehicle alone and transport objects on the front passenger's seat, like a briefcase, laptop etc.

For such cases, the customer has the option of having the SBR function disabled in the workshop. The SBR function for the front passenger side can be disabled with the coding option. In this case, only the audible warning, check control and text messages if applicable are suppressed. The seat belt mannikin in the instrument cluster remains on.

Deactivation of Passenger Airbags

The front and side passenger airbags must be disabled when a child seat is mounted on the passenger's side.

Deactivation and activation of the front passenger airbags is the responsibility of the driver.

Note: In US vehicles the law requires that a child seat tested to specifications (NHTSA FMVSS 208) with a child approximately one year old on the front passenger seat be automatically detected and the passenger airbags be deactivated.

When a child restraint system holding a small child tested in accordance with NHTSA FMVSS 208 is used, the law in the USA requires that this be automatically detected and the front passenger airbags deactivated. In order to meet legislative requirements, the step was taken to replace the seat-occupancy detector (SBE) with an intelligent Occupant Classification (OC) facility.

Passenger Airbag OFF Light

The passenger airbag OFF lamp is located at the front of the roof functions center FZD next to the interior lights. The passenger airbag OFF lamp is activated and lights yellow when the passenger's front airbag and the side airbag on the passenger's side are deactivated. The brightness of this light is controlled by automatic regulation of the display lighting.

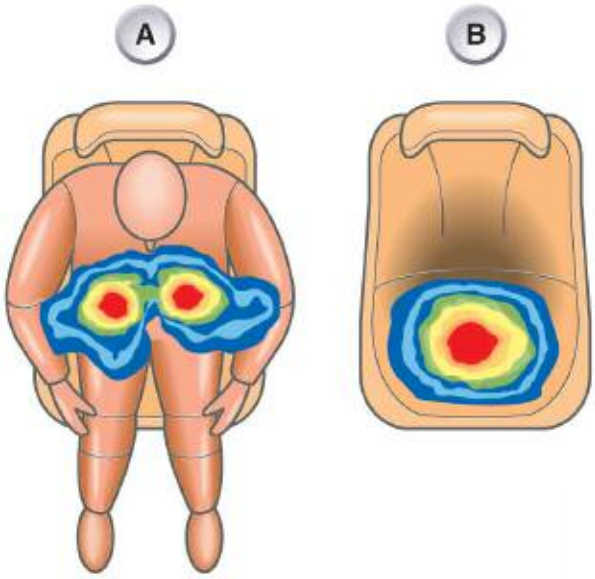
OC3 Mat

The OC3 mat (Occupant Classification) detects a child seat tested in accordance with NHTSA on the basis of the pressure per unit area and disables the passenger airbag.

The OC3 mat consists of conductors in a pressure-sensitive resistance grid, so-called FSR elements (Force Sensitive Resistance). The conductors are connected to the electronic evaluation unit.

The FSR elements are wired in such a way that they can be sampled individually. When The mechanical load on a sensor element increases electrical resistance decreases and the measurement current changes accordingly.

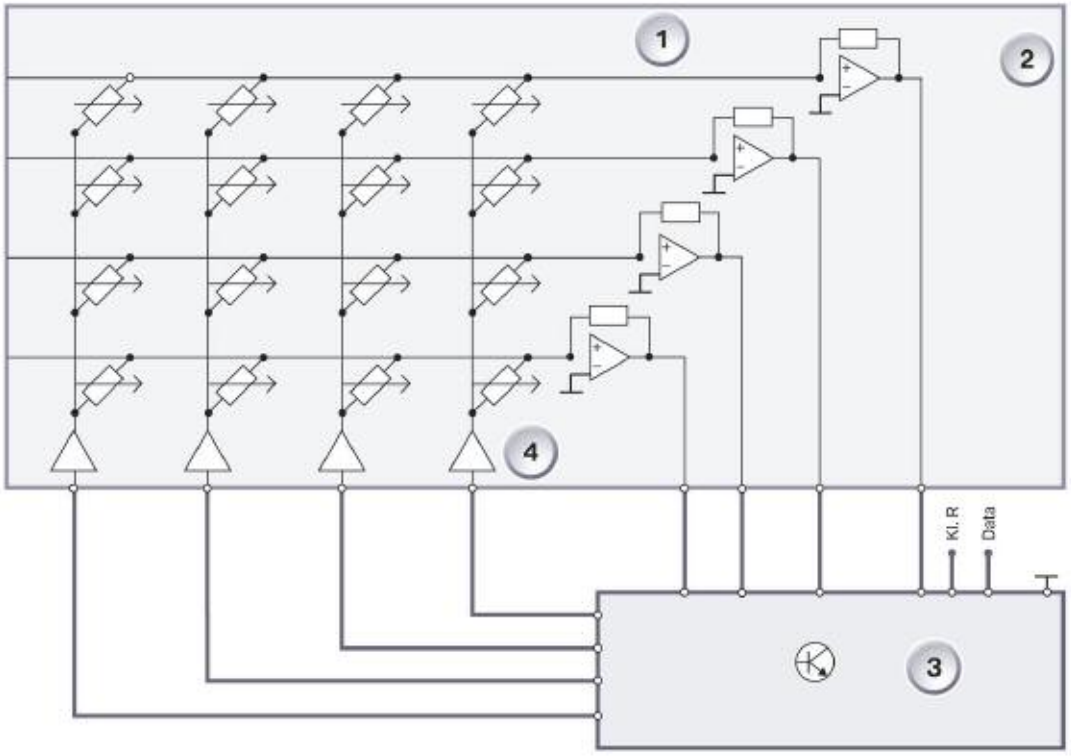
By analyzing the signals from the individual sensors, the analyzer can map the occupancy of the seat surface and identify local concentrations of weight. The relationship between the areas and the load points indicates whether there is a person or a child seat holding a small child present.



Index	Explanation
A	Surface imprint of a person
B	Surface imprint of a child seat

OC3 Mat E70

Block diagram of an OC3 mat E70



Index	Explanation	Index	Explanation
1	FSR elements	3	Electronic evaluation unit
2	Output monitoring	4	Input monitoring

The electronic evaluation unit of the OC3 mat sends a telegram via a separate K-bus to the crash safety module. The front passenger airbags (front and side airbags) are disabled when a child seat with small child is detected. The crash safety module activates the passenger airbag OFF indicator lamp in the roof functions center.

Note: The front passenger airbags are not deployed when the front seat is not occupied. However, this is not indicated by the Passenger Airbag OFF light.

System Components

Crash Safety Module

The advanced crash safety module essentially comprises the following components:

- Crash safety module
- Sensors and switches
- Actuators

The crash safety module is located centrally on the transmission tunnel in the vehicle.

The crash safety module consists of a die cast housing with integrated plug cover.

The crash safety module contains various sensors:

- Rollover sensor
- Low-g sensors
- Longitudinal and transverse acceleration sensors

The advanced crash safety module has a comprehensive sensor system. Transverse acceleration sensors in the B-pillar and door pressure sensors are used for the purpose of side-on crash detection. The B-pillar satellites also have longitudinal acceleration sensors for front- and rear-end crash detection.

Note: The crash safety module is located on the transmission tunnel behind the hand brake. Various sensors (rollover, Low-g as well as longitudinal and transverse acceleration sensors) are integrated in the crash safety module and the crash safety module is integrated in the K-CAN.

Sensors and Switches

In addition to the two sensors in the crash safety module, the system makes further use of the following sensors and switches to evaluate the crash severity and the corresponding triggering strategy:

- B-pillar satellites
- Up-front sensor
- Door pressure sensor
- OC3 Mat
- Seat belt buckle switches
- Airbag switch
- Emergency call button

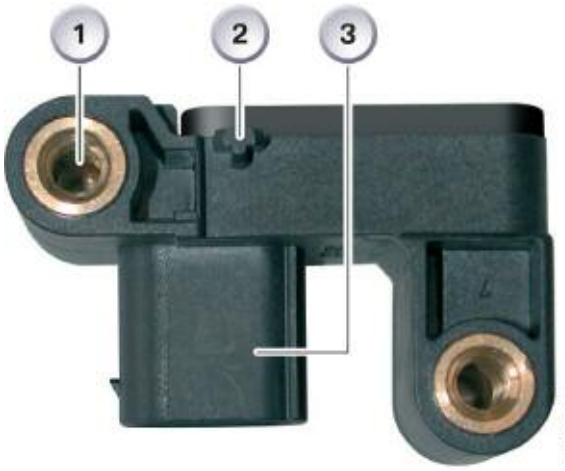
B-Pillar Satellite

The B-pillar satellite consists of a longitudinal acceleration sensor and a transverse acceleration sensor.

The acceleration sensors measure the positive acceleration and the negative acceleration (deceleration) in the X and Y directions. The resultant from the X and Y signals is the definitive factor in determining the direction of the impact.

The B-pillar satellites serve the purpose of detecting front-end, side-on and rear-end crashes.

The B-pillar satellites on the left and right are of identical design and are allocated by way of mechanical coding during installation.



Index	Explanation
1	Mounting points
2	Mechanical coding
3	Connection for cable plug

Note: Externally, the B-pillar satellites are identical to those on other BMW models. It is important to make sure the part number is correct. The airbag indicator lamp will come on if the incorrect satellites are installed.

Digital Data Transmission by Means of Current Interface

The recorded acceleration values of the micromechanical acceleration sensors are converted in an ASIC (Application Specific Integrated Circuit) into digital signals. With the aid of a data telegram, the digital signals are transmitted uni-directionally to the crash safety module.

The signals are transmitted via a current interface, which supplies the electronic circuitry with voltage.

The electronic circuitry receives a voltage level of about. 5-10 mA via the current interface. The level rises at a step of 20 mA when a data telegram is transmitted so that only two lines per measurement channel are required.

The transmitted data are evaluated in the crash safety module.

Up-Front Sensors

The up-front sensors in the front end on the left and right sides serve to detect a front-end crash. They deliver the initial information on the progress and severity of the collision to the crash safety module.

Each up-front sensor consists of an acceleration sensor for recording the deceleration/acceleration, a signal conditioner and an ASIC for data transmission.

The measured values are sent in the form of a data telegram to the crash safety module and are used in the calculation of the algorithm. The data are transmitted in the same way as the B-pillar satellites.

Door Pressure Sensors

The door pressure sensors in the front doors serve the purpose of verifying the plausibility of the acceleration signals from the B-pillar satellites and the crash safety module during side-on crash detection. The door pressure sensors are situated in the inner panels of the front doors and measure the increase in pressure within the door in the event of a side-on impact.

In the event of a side-on impact with the door, the outer door panel is pressed inward, thus reducing the inner door space and increasing the pressure. This change in pressure is measured by the door pressure sensors.

The door pressure sensor also includes an electronic module, which digitizes the pressure values and transmits them cyclically to the crash safety module. The data are transmitted in the same way as the B-pillar satellites.

The pressure values are evaluated in the crash safety module.

OC3 Mat

US legislation stipulates that the use of a child restraint system conforming to NHTSA and holding a small child on the front passenger's seat must be detected automatically and the front passenger airbag disabled.

The OC3 mat can detect an occupied child seat tested in accordance with the regulation (NHTSA FMVSS 208) on the basis of the pressure per unit area and disable the passenger airbag (front and side airbag). The passenger airbag OFF light comes on when a child restraint system tested in accordance with NHTSA and holding a small child was detected on the front passenger's seat.

Emergency Call Button

The emergency-call button is fitted as standard in US vehicles, even if no telephone has been ordered.

Seat-Belt Buckle Switches

The seat-belt buckle switches signal whether the seat belts are fastened or not. These switches transmit signals to the crash safety module and are used for triggering the required restraint systems and for the seat belt reminder function.

The seat belt buckle switch is located in the seat belt buckles of the driver's and front passenger's seat. The seat-belt buckle switch is designed as a two-wire Hall-effect switch. The crash safety module powers the Hall switch via a current interface. The current intake of the switch varies depending on whether the seat belt is fastened or not. The seat belt buckle switch is permanently monitored as from "Terminal R ON".

Actuators

The crash safety module is responsible for activating the following actuators:

- Front airbag, 2-stage, driver's side
- Front airbag, 2-stage, passenger side
- Head airbag, left and right
- Left and right side airbag integrated in the back rest of both front seats
- Seat belt pretensioner, front, left and right
- Adaptive seat belt force limiter, left and right
- Safety battery terminal

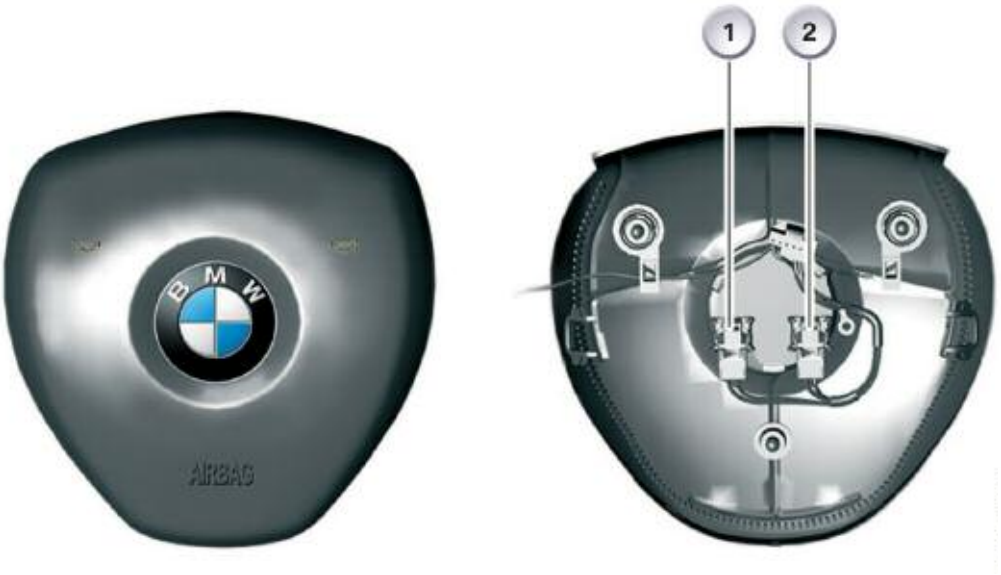
The following warning lamps are additionally activated:

- Airbag indictor lamp
- Seat belt indicator lamp
- Passenger airbag OFF light

Front Airbag, Driver

In conjunction with the seat belt, the driver's front airbag is designed to reduce the risk of serious injury to the driver's head or thorax during a head-on collision. The front airbag for the driver's side is located in the hub cushion of the steering wheel. The driver front airbag is equipped with a 2-stage inflator assembly.

The two stages of the airbag are triggered with a time delay depending on the crash severity and use of seat belt. The two stages of the inflator assembly facilitate a restraint function adapted to the crash severity and consequently reduce additional stress on the occupants during the development phase.



Index	Explanation
1	Connection of firing pellet, first stage
2	Connection of firing pellet, second stage

Front Airbag, Passenger

Together with the seat belt, the task of the front airbag on the passenger's side is to reduce the risk of serious injury to the front passenger during a frontal crash. The 2-stage front airbag on the passenger's side is located under the instrument panel.

Deployment of the front passenger airbag breaks the instrument panel at defined points and opens a flap, which is connected to the instrument panel by means of a fabric strap. The passenger airbag opens in the direction of the windshield. The passenger airbag emerges in an upward direction and is supported on the windshield and on the instrument panel.

Curtain Airbag

The well-proven curtain airbag is used as the head protection system in connection with the ACSM on the E70.

The curtain airbag extends from the A-pillar up to the C-pillar and covers the entire side section at head level. The curtain airbag inflates between the occupants and side windows or side trim panels.

In connection with the side airbag in the front seat, it provides optimum protection for the occupants in the event of side impact.

The curtain airbag reduces the movement of the head and other extremities towards the outside during a side crash. This results in lower neck shear forces as well as bending moments in the cervical vertebrae. In addition, it also prevents direct head contact with the side structure of the obstacle.

The inflator assembly (gas generator) mounted between the B-pillar and C-pillar is triggered in the event of a side crash. The gas flows out of the pressure vessel through the two gas lances into the curtain airbag.

Simultaneously filling the curtain airbag at the front and rear ensures the air cushion is filled uniformly.

The head airbag is brought into position because of the way the curtain airbag is mounted on the A-pillar and the C-pillar. The curtain airbag extends between the side window and side trim panel and the occupants.

The closed system retains the structural strength and stability of the curtain airbag for several seconds

Side Airbag

For many years now, the side airbag has been used at BMW as an important integral part in occupants safety and protection systems. The task of the side airbags is to minimize the risk of injury to the driver/front passenger in the trunk/torso area in the event of a side impact.

The side airbags mounted in the back rest of the front seats with the aim of achieving optimum interior functionality and appealing design in the E70 while also satisfying the demanding safety requirements. The task of the side airbags is to minimize the risk of injury to the driver/front passenger in the pelvic and trunk/torso area in the event of a side impact.

The side airbag is triggered in response to a sufficiently strong pulse from the side. The side airbag emerges through the tear seam in the backrest and inflates between the door and occupant. The air cushion between the door and occupant provides controlled damping and therefore reduces load/strain on the occupant.

Front Seat Belt Pretensioner

The task of the pyrotechnic seat belt pretensioner is to minimize the seat belt slack in the pelvis and shoulder areas in the event of a crash, thus also preventing "submarining", i.e. slipping under a slack seat belt.

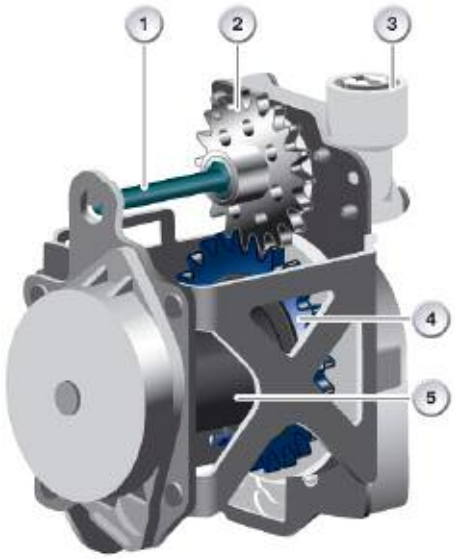
The seat belt pretensioners are located on the driver's, front passenger's and left and right rear seats. The seat belt pretensioners are fired in the event of a front- or rear-end crash. In the E70 they are also activated in the event of an imminent rollover.

Index	Explanation
1	Before triggering
2	After triggering

Adaptive Seat Belt Force Limiter

The pyrotechnic seat belt force limiter for the driver and front passenger is designed as a seat belt retractor with adaptive force limitation. The force is changed over from a high level to a lower level with the aid of a gas generator. This must also be possible during a crash in order to achieve gradual force reduction.

The kinetic energy of the occupant is uniformly reduced over the duration of the crash thanks to optimum matching with the airbag, thus achieving lower occupant stress values. Adaptive force limitation is achieved in that a second torsion shaft can be optionally coupled or de-coupled by the main torsion shaft.

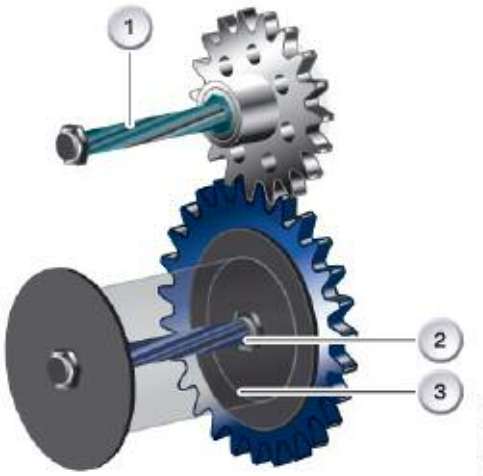


Index	Explanation
1	Second torsion shaft
2	Gearwheel on second torsion shaft
3	Pyrotechnic actuator
4	Gearwheel on first torsion shaft
5	Seat belt reel

Adaptive Seat Belt Force Limiter Positive Engagement

The belt force is transmitted through the seat belt webbing to the belt reel.

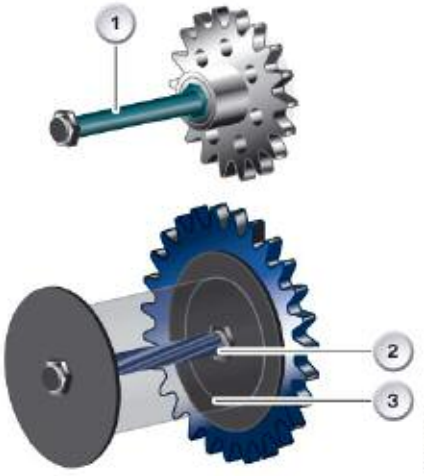
When the two gear wheels are positively engaged, the two torsion shafts rotate as the result of the force applied by the belt. The torque of the two torsion shafts counteracts the belt force.



Index	Explanation
1	Second torsion shaft
2	First torsion shaft
3	Seat belt reel

Adaptive Seat Belt Force Limiter Non-Positive Engagement

When the pyrotechnic actuator is triggered, the second torsion shaft shifts upward thus disengaging from the first gearwheel. Only the first torsion shaft is now subjected to the torque of the belt and therefore turns at a greater rate.



Index	Explanation
1	Second torsion shaft
2	First torsion shaft
3	Seat belt reel

Safety Battery Terminal

The safety battery terminal is triggered at different thresholds when the crash safety module detects a front-end, side-on or rear end crash of sufficient severity. The connection between battery and starter/ alternator cable is then separated by pyrotechnical teams. At the same time, the alternator is switched off by means of a crash telegram sent to the DME. The safety battery terminal is located directly at the positive terminal of the battery.

Service Information

General Safety Regulations

The safety information provided in the repair instructions must be complied with whether working on the safety system, particularly on the airbag units and the seat belt pretensioners. This requirement applies particularly to disassembly and assembly jobs.

- Only qualified and specially trained personnel are permitted to perform testing and assembly jobs on the safety systems.
- All work on components of the airbag system must be carried out with the negative terminal disconnected.
- The specified waiting time must be allowed to elapse to discharge the capacitors (>30 s)
- The battery must be completely disconnected when performing electric welding work on the vehicle.

Crash Safety Module

Crash entries

In the event of a crash where one or more actuators are triggered, a crash entry is stored in a non-erasable memory. After three crash entries, a non-erasable fault entry is stored in the fault memory with the instruction to replace the crash safety module.

Fault entries

The entry of a triggered restraint system in the fault memory does not mean that the restraint system was defective in the crash situation, rather it only means that the restraint system is not available for further triggering.

B-pillar Satellite

Visually, the B-pillar satellites look like those on other BMW models. However,they transmit different data protocols. It is important to make sure the part number is correct. The airbag indicator lamp will come on if the incorrect satellites are installed.